Loneliness as Viewed from an Interactive Temperamental Model

A Senior Honors Thesis

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Abstract

A growing body of research reveals that loneliness has the potential to negatively impact physical and mental health. Therefore it is important to improve our understanding of risk factors for loneliness. Among those factors are dimensions of personality/temperament. However, extant studies of such factors are limited in that they have focused purely on main effect relations. Current models of temperamental risk emphasize interactive relations among such dimensions. For example, Rothbart's model emphasizes interactions between two reactive dimensions (i.e., negative and positive affectivity; NA and PA) and one self-regulatory dimension (i.e., effortful control; EC) in relation to a wide range of outcomes including anxiety and depression. The current study extends this model for the first time to loneliness. Three interactions were predicted (i.e., NA x PA, NA x EC, and PA x EC) and tested in a context in which risk for loneliness is high: the transition into college life. In a sample of 146 first-quarter, college freshmen, contrary to expectation with expectation, we did not find significance in our predictions. Although hypotheses did not achieve significance, the magnitude of the effect sized was sufficient to be significant in a bigger sample size. Implications for future research are discussed.

Introduction

Loneliness is defined by Ernst and Cacioppo, (1999) as "a complex set of feelings encompassing reactions to the absence of intimate and social needs (p. 1)." People rate social connection as a factor that contributes to happiness more so than wealth or physical health (Berscheid,E. 1985 as cited in Cacioppo and Patrick, 2008). Furthermore, feeling isolated from others impacts health just as much as high blood pressure, smoking, or obesity (House, Landis, & Umberson, 1988). For people who feel the "social pain," as Cacioppo and Patrick call loneliness in their book "*Loneliness*," loneliness functions like any other pain: to protect us from danger. Physical pain protects people from physical danger. In the case of loneliness, the social pain is a cue that people could use to engage in a social group. (Cacioppo and Patrick, 2008). Furthermore, functional magnetic imaging (fMRI) shows that the experience of loneliness activates the same emotional region of the brain activated when people experience physical pain, the dorsal anterior cingulate (Cacioppo and Patrick 2008).

When loneliness becomes chronic it changes the person in all aspects of their lives. It implies a change in the person's behavior as well as a change in their perceptions about the world (Cacioppo and Patrick, 2008). People who experience chronic loneliness may see others as threatening and as a consequence isolate themselves even more (Cacioppo and Patrick, 2008). Research has shown that the effects of loneliness go beyond those related with social issues. As loneliness persists, the perceived loss of personal control leads to passive attitude, a common condition in people who suffer depression. This passivity is what leads people to fail when trying to overcome loneliness (Cacioppo and Patrick, 2008). Lonely people may not only react more to the negatives but also they may enjoy less the positives (Cacioppo and Patrick, 2008).

Although nearly everyone experiences periods of acute loneliness, people vary widely in the likelihood that their loneliness persists. There are individual differences in terms on how sensitive a person is to the feeling of loneliness. Someone who is alone may not feel lonely while other can feel isolated despite being in the company of friends or family. Research to date has largely focused narrowly on factors like the size or quality of social network as risks factors for persistent loneliness. However, findings are inconsistent (for a review see Jackson, Soderlind, &Weiss, 2000). Researchers are gradually focusing their attention in studying the personal factors that increase a person's risk for loneliness. Research has found positive correlations between pessimism and shyness with loneliness (see Jackson et al. 2000). However, many potential risk factors remain unexamined. Among those with greatest potential are aspects of temperament or personality.

Although personality correlates have been studied, extant work has been limited thus far to investigation of main effects. However, recent models of personality and temperament have emphasized the importance of interactions among personality and temperamental dimensions (Shahar, Gallagher, Blatt, Kuperminc, & Leadbeater, 2004). Temperament is the individual differences people have in motivational reactivity and self-regulation (Rothbart and Derryberry, 1981 as cited in Verstraeten, Vasey, Raes, & Bijttebier, 2009). Reactivity is defined as the individual differences in "emotional arousability" consisting on NA and PA whereas self-regulation is a process by which people exert the ability to adapt reactive motivations. Self-regulation is a voluntary course of action depending on attentional and inhibitory processes (Derryberry and Rothbart, 1997).

NA has been defined as the temperamental propensity to experience unpleasant arousal (Watson and Tellegen, 1985). NA includes the level of vulnerability to reactive emotions such as

fear, disgust, sadness, anger, guilt, and hostility (Watson, Clark. & Carey 1988; Watson and Clark 1992). As a trait, NA is the tendency for people to experience negative emotions that have a broad impact in their lives. High levels of NA have been associated with a wide range of negative outcomes both psychological and physiological in nature (Watson and Clark 1984). NA is widely known to be associated with psychopathology, including depression and anxiety (Watson, Clark & Carey 1988; Clark and Watson 1991; Watson and Tellegen 1985) and as a consequence the two conditions are often found to be comorbid (Dobson 1985; Kendall, Kortlander, Chansky & Brady 1992).

Although there is little research on personality traits as risk factors influencing how a person experiences loneliness, there are several studies linking NA to distress when alone. For example, in a study on 10-month-old infants' response to maternal separation researchers found through electroencephalographic (EEG) measures, that those infants who cried more when separated from their mothers showed a greater right frontal activation than infants who did not show such an activation. Researchers reported that the right frontal region is more active when experiencing negative emotions (Davidson & Fox, 1989). Researchers found brain asymmetry to be a marker of affective temperament with individual differences on the ability to tolerate stressful events and vulnerability to certain emotions (Davidson & Fox, 1989). In a study to identify patterns of behavior and emotional response to peer rejection, middle-school students were administered assessments. Among the rejected students those in the submissive group reported being more lonely than those who were aggressive. Results indicated that both aggressive-rejected and submissive-rejected students were deficient in positive qualities (Parkhurst and Asher, 1992). According to Ernst and Cacioppo, (1999) children with NA who suffer peer rejection may be more likely to experience loneliness than those rejected children who do not have NA.

PA is the degree to which a person enjoys life and has the ability to engage positively with the environment (Watson and Tellegen, 1985;Watson, Clark & Carey, 1988). High levels of PA are linked to the ability of a person to feel enthusiasm, happiness, vigor, curiosity, and determination (Watson, Clark & Carey, 1988). On the other hand, low levels of PA are associated with low energy and mental or physical exhaustion (Watson, Clark & Carey, 1988). As previously mentioned, someone who suffers from persistent loneliness is more likely to be passive. Someone low in PA is prone to be low in energy, be passive. Someone who is already passive may be more prone to suffer from persistent loneliness. Therefore, someone who is low in PA and suffers from acute loneliness is more prone to suffer from persistent loneliness. Low levels of PA are associated with higher level of depression symptoms (Verstraeten et al. 2009). As previously mentioned, high levels of NA are also associated with depression. However, NA and PA are not opposite constructs. PA and NA are two independent constructs; the level of one construct does not determine the level of the other (Watson and Tellegen, 1985). In other words, a person high in levels of NA could also be high in levels of PA. According to Clark and Watson's (1991) tripartite model depression is the outcome of someone having high levels of NA and low levels of PA. However, there are not many studies have tested these two traits as interacting factors. In a cross-sectional study testing the interaction NA x PA, researchers found that high levels of NA were more strongly associated with the prediction of conduct problems in adolescence at low levels of PA than when PA was high (Loney, Lima & Butler, 2006). Another study tested the interaction NA x PA to predict depression such that high levels of NA were more strongly associated with depression when PA was low than when it was high (Joiner and Lonigan, 2000).

Work by Fredrickson directs attention to NA x PA interaction. The broaden-and-build theory of positive emotions proposes that experiencing high levels of positive emotions such as

excitement, joy, enthusiasm, hope and pride buffer the effect of negative emotions (Fredrickson, Cohn, Coffey, Peck, & Finkel, 2008). Positive emotions lead people to be more satisfied with their lives (Cohn, Fredrickson, Brown, Mikels & Conway, 2009), live longer (Danner et al. 2001), and therefore, experience less symptoms of depression (Fredrickson et al. 2008; Cohn et al., 2009). According to the "undoing hypothesis," having positive emotions will undo the effects of negative emotions (Fredrickson, 1998). Negative emotions narrow the momentary attention to the negative emotion being experienced at that moment by triggering specific reactions such as running away or attacking (Cohn et al. 2009; Fredrickson, 1998). For instance, whereas being angry leaves no resources to pay attention to any other emotion (Cohn et al. 2009) experiencing positive emotions broadens the capacity to pay attention (Fredrickson, 1998). The experience of positive emotions allows people to build lasting resources that help to deal with life's challenges that people have to encounter on a daily basis (Cohn et al. 2009). Although Fredrickson talks about states of emotion this concept could also be applied to the trait of PA. In other words, a person high in NA is prone to negative emotions as in Fredrickson's model, but a person's level of PA will be a significant determinant of their exposures to positive emotions. Thus, we should expect that high levels of PA moderates the relationship between NA and loneliness, reducing the risk for chronic loneliness among individuals who are otherwise vulnerable due to high levels of NA.

Effortful control (EC) is the self-regulation component of temperament that gives a person the ability to dominate an initial reactive tendency and replace it with a more adjusted response (Posner and Rothbart, 2000). EC is the "ability to inhibit a dominant response to perform a subdominant response " (Rothbart and Bates, 1998, p. 137 as cited in Lonigan and Vasey, 2009). According to the model proposed by Lonigan and Philips, (2001) EC is considered to be an important moderator of the risk for a person to experience high levels of NA. The notion of EC

was first introduced to illustrate the capacity of a person to self-regulate that emerges in childhood and allows the child to gain control over which emotional and behavioral response to express (Rothbart, 1989). EC is explained as a construct that has three main aspects: inhibitory control, which is the ability to inhibit a specific behavior with effort when appropriate, activation control is the ability to activate a behavior when it is needed, and attentional control is the ability that a person has to change the attention from one stimulus to another (Verstraeten, Vasey, Raes, & Bijttebier, 2009).

Self-regulation is the ability to control a reaction in favor of a more socially acceptable behavior (Baumeister, DeWall, Ciarocco, & Twenge, 2005). Cacioppo and Patrick, 2008 found that people who feel lonely lose the ability to use self-regulation and as loneliness becomes persistent a "disregulation" occurs leaving the person more vulnerable to other stressors and less capable to cope with them. In one experiment, a group of people was told that they had to perform a task by themselves because nobody wanted to work on the task with them. As a consequence, that group ate more cookies than the other group of participants. The number of cookies that were eaten was the measure used to test the ability of people to self-regulate (Baumeister et al. 2005). Also, in another experiment researchers used persistency on unsolvable puzzle to measure self-regulation. Participants in the experimental group were told that they would likely end up alone in life. As expected, participants in the experimental group gave up sooner on the frustrating task than participants in the control group (Baumeister et al. 2005). Furthermore, research has found loneliness to be associated with high levels of NA, and low levels of positive affectivity (PA) (see Ernst and Cacioppo, 1999).

Extensive research shows that EC acts as a moderator between NA and anxiety problems (see Muris et al. 2007; Muris, 2006). In fact, according to the model proposed by Lonigan and

Philips, (2001) high levels of NA by itself are not sufficient to develop psychopathology. According to their model, high levels of NA and low levels of EC are needed in order for anxiety problems to develop. Low levels of EC act as a risk factor that interacts with NA to make a person more vulnerable to anxiety and depression (Lonigan, Vasey, Philips, & Hazen, 2004). EC is a factor that protects people who are prone to high reactive vulnerability against depressive symptoms. NA's association with depressive symptoms is stronger when EC is low than when it is high (Verstraeten et al. 2009).

Furthermore, EC also modulates the association between PA and depressive symptoms. The association between low levels of PA and risk for depression is highest when EC is low than when it is high (Anthony, Lonigan, Hooe, & Philips, 2002). In a cross-sectional and longitudinal study Verstraeten et al. 2009 found that high levels of NA, low levels of PA, and low levels of EC were associated with higher levels of depressive symptoms in a sample of seventh-through tenth-graders. Cross-sectionally they found that the association between NA and PA with depressive symptoms was moderated by the level of EC. In other words, high NA and low PA were associated with higher levels of depressive symptoms only when EC was low suggesting a three way interaction. Among the girls, researchers found an interaction between PA and EC. Low levels of PA were more strongly associated with depressive symptoms when EC was low. This result was consistent with the view of EC as a protective factor against reactive susceptibility such as high NA in boys and low PA and high NA in girls.

As noted, there is extensive research on the association between the reactive components and the regulatory component of temperament with risk for depression and anxiety but it is important to note that loneliness has also been found associated low levels of EC as well as high NA and low PA, as previously mentioned. However, there is no research published to date that

test the interaction of the temperament components and their association with loneliness. This study is new in two ways. Although there is some research on the interactions of NA and PA there is no research looking at interactions in the context of loneliness. Also, most of the research done in interactions is mostly cross-sectional. This study was longitudinal in that it covered the ten weeks of a quarter. The question in this study is what are the temperamental characteristics that make certain individuals stay lonely even after a reasonable period of adaptation during which most of their counterparts manage to successfully engage in a social group. To see how loneliness unfolds in college students across their freshmen quarter we tested the interaction of PA and NA in the context of loneliness. Consistent with past studies we expect that there will be a positive correlation between NA and loneliness as well as a negative correlation between PA and loneliness. Further, we predict that there will be an interaction between NA and PA. That is, NA's association with loneliness should vary depending on the level of PA such that NA should be more strongly associated with loneliness when PA is low than when PA is high. Therefore, we expect that those participants who report simultaneously higher levels of NA and lower levels of PA will be most likely to be acutely lonely at the beginning of the quarter, as well as to stay lonely across the quarter. On the other hand, participants who report high levels of PA will be more likely to report reduced loneliness at the end of the quarter even when experiencing high levels of NA than those reporting low levels of PA.

Another interaction tested in the same context was EC and PA. We predicted that the relationship between PA and loneliness would be moderated by EC such that low levels of PA will be more associated with loneliness when EC was low. Those participants who are low in PA will need to use more self-regulation in order for them to acquire the energy required to engage in social activities. We expect that those participants who report lower levels of PA and low levels of

EC will be most likely to stay lonely across the quarter. We also tested the interaction between NA and EC to predict loneliness across the quarter. Our hypothesis was that higher levels of NA were more strongly associated with loneliness when the participant reported lower levels of EC.

Method

Participants

Because interactions are hard to find in field research, it is essential to maximize power to find the interaction in this study. An adequate test of moderation requires maximization of variability on NE and PE. The most important subjects in this study are those who are simultaneously extreme in NE and PE. Therefore, Introductory Psychology students were screened at the beginning of the Autumn 2010 quarter for high levels of NE (at median or above) and low and high PE (at median or above) using a brief version of the Affect Intensity Measure (AIM; Bryant, Yarnold & Grimm 1996) and a brief version of the Effortful Control Scale (EC Scale; Lonigan and Phillips, 2001) to permit oversampling the extremes, as recommended by McClelland and Judd, (1993). We invited all individuals who scored at the median or above on a measure of NE and also those low in NE and low in PE at pre-screening. We also invited a random subsample from the broader distribution to maximize our variability. From the invited sample, we selected those who were first-quarter freshmen. The sample included 48 male and 129 female participants. By participating in the study, students received partial credit towards the class.

Measures

Adult Temperament Questionnaire (ATQ; Rothbart, Ahadi, & Evans, 2000)

The ATQ is a 77-item self-report questionnaire meant to measure constructs of effortful-

control, negative affect, extraversion/surgency, and orienting sensitivity. Participants answered the questionnaire online the first time they visit our website, the second week of class (T1). Participants will respond to questions such as " *I rarely feel sad after saying goodbye to friends or relatives*" on a 7-point likert-type scale (1 = *extremely untrue* to 7 = *extremely true*). They will also have the option to mark their answer as "not applicable", if the question does not apply to them. Items measuring orienting sensitivity (items 10,13,18,21,24,33,39,41,52,57,62,66,69,71, and 74) were not included in the questionnaire. Previous research has shown good internal consistency, concurrent validity, and predictive validity (Rothbart et al. 2000).

Affect Intensity Measure (AIM; Bryant, Yarnold, & Grimm, 1996)

The AIM is a 27-item self-report questionnaire scored on a 5-point scale (1 = *never* to 5 = *always*). It is designed to measure how strong people experience positive and negative emotions as well as their reactions to those emotional experiences. Participants responded to the questionnaire during the second week of classes (T1). Previous research has shown good discriminant validity and internal consistency (Bryant,F.B. et al. 1996).

UCLA Loneliness Scale (Russell,D., Peplau,L.A., & Cutrona,C.E., 1980)

Participants responded to the UCLA Loneliness Scale when they visited our website at T1 and at the end of the quarter, week 9 (T2). This questionnaire is a 20-item self-report on a 4-point scale (1= *never* to 4= *often*). This questionnaire measures both satisfaction as well as dissatisfaction with social relationships. There are 10 questions that are positively worded and 10 negatively worded. The value of the positive items are reversed for scoring. Internal consistency is high (coefficient alpha = .94) (Booth, Bartlett, & Bohnsack, 1992). We provided instructions at

T1 that read: *"The following statements describe how people sometimes feel. For each statement, please indicate how often you felt that way during your **senior year in high school**."* Additionally, at T1 and T2 the instructions were: *"The following statements describe how people sometimes feel. For each statement, please indicate how often you felt that way over **the past week**."* Research has demonstrated the UCLA loneliness Scale to have high internal validity, as well as concurrent validity, and discriminant validity (Russel,D. et al. 1980).

Procedure

In a larger battery of measures, participants completed questionnaires in five sessions that occurred at various points of the quarter. This study is only concerned with session 1 (T1), and session 5 (T2). Participants gave informed consent at the start of the study. At T1 participants filled out a demographics questionnaire to get information such as age, living arrangement (on-campus, off-campus but not at home, at home), and academic status. Six different orders of the questionnaires were used to control for potential order effects. For each session, participants received an email with a link to the questionnaires, which were to be completed within one week at a convenient time for the participant and from any computer. At T1, among other measures, they completed the ATQ, the AIM, and the UCLA Loneliness Scale regarding their high-school experience as well as the version asking about loneliness in the past week. At T2 participants completed the UCLA Loneliness Scale with regard to the past week.

Results

Data-Analytic Strategy and correlations

All analyses reflect data for 146 (105 female) participants having complete data for T1 and

T2 questionnaires[1]. Table 1 shows descriptive statistics and correlations for all measures. As Table 1 shows, NA was positively correlated with Loneliness T1 ($r = .225$, $p < 0.01$), as it was correlated with Loneliness T2 ($r = .17$, $p < 0.05$). As was predicted, PA was negatively correlated with Loneliness T1 ($r = -.36$, $p < 0.01$), and with loneliness T2 ($r = -.43$, $p<0.01$). However, we did not find a correlation of EC with loneliness PW T1 ($r = -.09$, ns), but we did find a significant negative correlation between EC and loneliness T2 ($r = -.27$, $p < 0.01$). There were not significant differences between Loneliness T1 and Loneliness T2 (Loneliness T1: M = 40.61, SD = 10.24; Loneliness T2: M = 39.55, SD = 10.94; t = 1.20, ns).

Table 1. Correlations and descriptive statistics for primary measures.

	1	2	3	4	5	6	*M*	*SD*
1. Sex	---						1.73	0.45
2. ATQ NA	.292**	(1)					103.42	18.41
3. ATQ PA	.124	–.091	(1)				23.83	5.12
4. ATQ EC	–.130	–.418**	.190*	(1)			81.78	14.12
5. UCLA Loneliness T1	–.072	.194*	–.383**	–.071	(1)		40.73	10.36
6. UCLA Loneliness T2	–.154	.171*	–.417**	–.267**	.488**	(1)	39.54	10.86

Note: $n = 144$[1]. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). Sex = 1 (male) or 2 (female). ATQ NA = Negative Affectivity Subscale of Adult Temperament Questionnaire – Trait Form; ATQ PA = Positive Affectivity Subscale of Adult Temperament Questionnaire – Trait Form; ATQ EC = Effortful Control Subscale of Adult Temperament Questionnaire – Trait Form; UCLA Loneliness = University of California Los Angeles Loneliness Scale

Cross-Sectional Association between Temperament and Loneliness at T1

It was hypothesized that high levels of NA would be more strongly associated with loneliness at low levels of PA. Also, it was hypothesized that low PA would be more strongly associated with loneliness at low EC, and finally, it was hypothesized that high NA would be more strongly associated with loneliness at low EC. The interaction effect was tested using product terms computed from z-transformed "main effect" variables. The predictions were tested through hierarchical multiple regression, containing three steps. In the first Step 1, we included sex. Step 2 added NA, PA, and EC. Step 3 added the two-way interactions between the temperament components (e.g., NAxPA, PAxEC, ECxNA) to see if this addition affects the outcome and if the increment of R^2 is significantly higher than in Step 2. Examination of regression diagnostics strongly indicated that results were influenced by two cases. Therefore, these cases were dropped. As summarized in Table 2, sex in Step 1 accounted for .2% of the variance in loneliness. In Step 2 the variables included accounted for 18.9% of the variance in loneliness T1. Results revealed main effects for NA and PA. Step 3 accounted for 1% of the variance in loneliness T1. However, none of the interactions was significant.

Prospective Association between Temperament and Loneliness at T2

Regression analyses predicting Loneliness at T2 were similar to the cross-sectional analyses. Additionally, in all analyses we controlled for Loneliness at T1. Thus, in the first Step we included sex and Loneliness T1. Step 2 included NA, PA, EC. In Step 3 we included the interactions NAxPA, NAxEC, and ECxPA. As summarized in Table 2, Loneliness at T1 in Step 1 accounted for 25.2% of the variance in loneliness at the end of the quarter. In Step 2 the variables included accounted for 10.1% of the variance in loneliness at the end of the quarter. In Step 3 the

variables included accounted for 2.1% of the variance in loneliness at the end of the quarter. Results revealed that Loneliness T1, PA, and EC were the best predictors of Loneliness T2. None of the interactions were found significant.

Table 2. NA, PA, and EC regression models predicting Loneliness at T1 and Loneliness at T2 (controlling for Loneliness T1).

	UCLA Loneliness Scale at T1				UCLA Loneliness Scale at T2			
Step/Variables Added	R^2	ΔR^2	B (SE) at Final Significant Step	*sr* at Final Significant Step	R^2	ΔR^2	B (SE) at Final Significant Step	*sr* at Final Significant Step
Step 1:	.002				.252**			
Constant			–6.132E-17 (.07)				.020 (.07)	
z-Sex			–.044 (.08)	–.04			–.119 (.07)	–.14
z-Lonely T1							.497** (.08)	.48
Step 2:	.191**	.189**			.354**	.101**		
Constant							.018 (.07)	
z-Sex			–.051 (.07)	–.05			–.136 (.07)	– .16
z-Lonely T1							.389** (.08)	.39
z-NA			.218** (.08)	.20			.035 (.08)	.04
z-PA			–.366** (.07)	–.37			–.218** (.08)	–.23
z-EC			.054 (.08)	.05			–.214** (.08)	–.22
Step 3:	.201**	.010			.374**	.021		
Constant							.046 (07)	
z-Sex			–.057 (.17)	–.06			–.148* (.07)	– .17
z-Lonely T1							.364** (.08)	.37
z-NA			.209** (.08)	.20			.036 (.08)	.04
z-PA			–.375** (.07)	–.38			–.229** (.08)	–.24
z-EC			.052 (.08)	.05			–.196* (.08)	–.20
NAxPA			.019 (.08)	.02			.099 (.08)	.11
NAxEC			.079 (.06)	.11			.093 (.06)	.12
PAxEC			.025 (.08)	.02			.084 (.08)	.09

Note: sr = semi-partial correlation; ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at 0.05 alpha level (2-tailed).

NAxPA Interaction predicting Loneliness at T2

Contrary to expectations we did not find a significant interaction between NA and PA to predict loneliness. As figure 1 shows, participants reporting high levels of PA, increasing levels of

NA were related to increase in risk for staying lonely across the quarter. However, participants reporting low in PA, variation in NA did not make a difference in how loneliness developed across the quarter. These results suggest that low levels of NA by itself predict persistent loneliness across quarter and NA does not affect that prediction. In addition, participants with both low PA and high NA may be at similar risk for persistent loneliness compared to participants who have either trait alone.

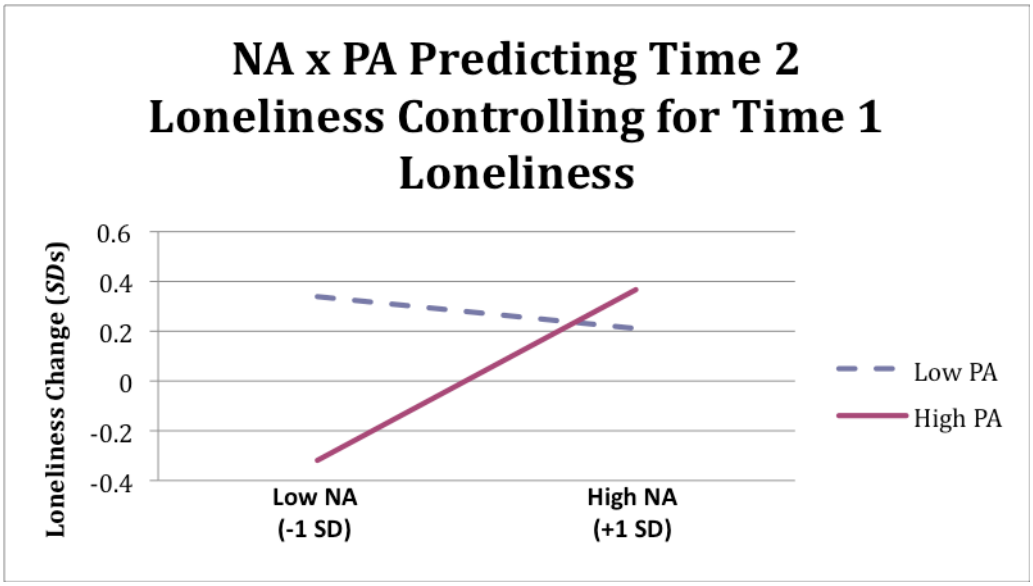

Fig. 1 PA x NA interaction predicting Loneliness at T2 controlling for Loneliness at T1

PAxEC Interaction predicting Loneliness at T2

Even though we the interaction PAxEC did not achieve significance, figure 2 shows proximity to our predicted interaction. A person is at higher risk for persistent loneliness across the quarter when there are reports of low levels of PA and low levels of EC. On the other hand, when levels of EC are high there is a weaker association between PA and loneliness. The trend of the results confirmed the direction of the prediction. As figure 2 shows EC acts as a moderator in the association between PA and loneliness.

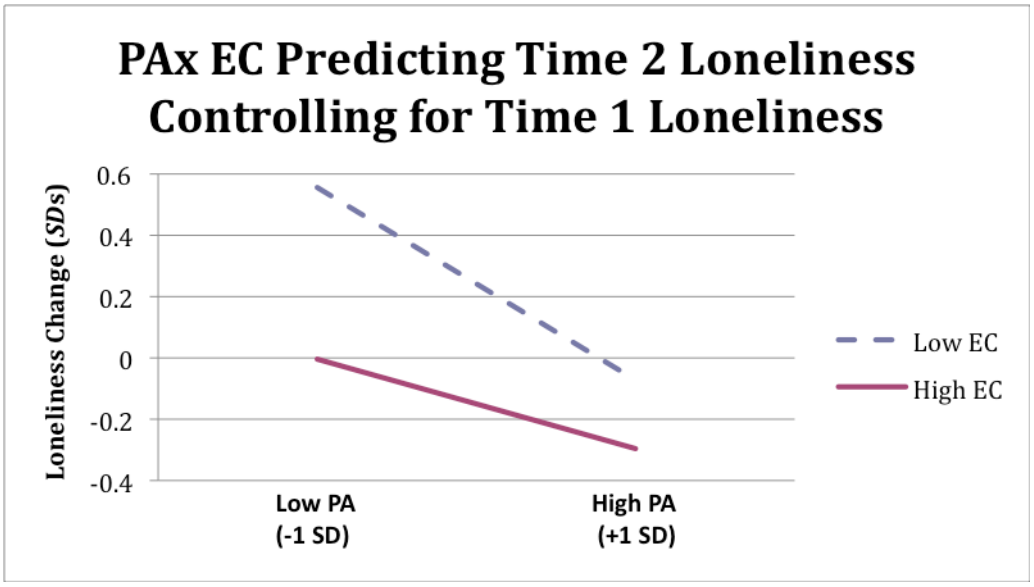

Fig. 2 PA x EC interaction predicting Loneliness at T2 controlling for Loneliness T1

NAxEC Interaction predicting Loneliness at T2

Although no interaction NAxEC was found, figure 3 shows a trend in the results. Low EC is associated with stable loneliness regardless of the level of NA. However, when EC is high, loneliness decreases across the quarter if NA is low but it stays stable when NA is high. What these pattern of results suggests that one way to reduce loneliness is for a person to be high in EC and low in NA. If a person is low in EC, or high in NA, or both they are at risk for increased loneliness across the quarter.

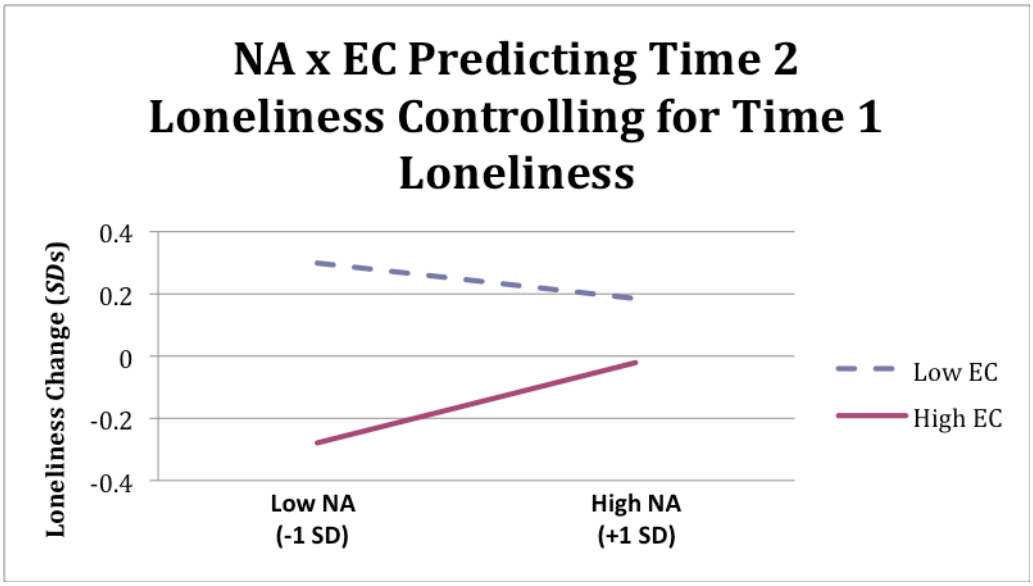

Fig. 3 NA x EC interaction predicting Loneliness at T2 controlling for Loneliness T1

Discussion

The present study examined the roles of the temperament factors in loneliness and how they interacted to predict loneliness across time. As expected, the zero-order correlations between the dimensions of temperament and loneliness were consistent with the hypothesis proposed that temperament characteristics play a role in the development of loneliness. Cross-sectionally, we found main effects for NA and PA. Consistent with past research low PA was negatively correlated with Loneliness at T1. High NA was positively correlated with Loneliness at T1. Unexpectedly, EC was unrelated to Loneliness at T1. However, when the temperament components were considered as interacting factors to predict Loneliness at T1, neither one of the interactions tested (i.e., NAxPA, PAxEC, and NAxEC) were found to be significant.

As expected, in the prospective analysis Loneliness at T1 was a significant predictor of Loneliness at T2. Main effects were found among two of the temperament factors. PA and EC contributed significantly to the prediction of Loneliness at T2 after controlling for Loneliness at T1. However, when temperament components were introduced in the regression model as interacting variables (i.e., NAxPA, PAxEC, and NAxEC) results showed that none of the interactions were significant. The first interaction tested, NAxPA failed to show a significant interaction to predict loneliness and the direction of the pattern of results were not as predicted. However, results were consistent with previous research that found that children with high levels of NA, low levels of PA, and high levels of NA combined with low levels of PA did not differ from one another (Olino, Klein, Dyson, Rose, & Durbin, 2010). Another recent study looking at risk for depression in children found that children low in PA and high in NA were at the same risk for depression as children who had vulnerability in either one trait alone (Shankman, Klein, Torpey, Olino, Dyson, Kim, Durbin, Nelso, & Tenke, 2011). Results show a trend in the results indicating that an interaction may have been achieved with a bigger sample.

ECxPA was not found to be significant but the direction of the trend in the results was as predicted. Low PA is more strongly associated with loneliness when EC is low. As previously mentioned, persistent loneliness leads to a passive attitude, which in turn leads people unable to overcome such persistent loneliness (Cacioppo and Patrick, 2008). Furthermore, low levels of PA are associated with low energy and mental or physical exhaustion (Watson, Clark & Carey, 1988), which is the same as to say that someone low in PA is passive. If we take this into consideration, people who are more likely to end up passive when lonely are those who are already passive. The lack of approach that people low in PA are prone to and their inability to use self-regulation to be able to approach are more likely to persist in their loneliness as the results showed. Cacioppo and

Patrick (2008) also talk about how a person who suffers from persistent loneliness lose the ability to self-regulate, and looking at the results it makes sense that a person who reports high levels of loneliness is low in EC.

The interaction NAxEC was not significant. The pattern in this results suggested that low levels of EC are a predictor of the development of loneliness across time by itself, not in combination with levels of NA. Somebody high in NA, low in EC, or a combination of both is at the same risk for persistent loneliness. Although, consistent with previous research, a person is at highest risk for increase in loneliness when their report in EC is low.

This was the first study testing temperament interactions in the context of loneliness. We did not find any significant results for our predictions. However, we did find main effects for NA and PA predicting loneliness at T1 and main effects for EC and PA predicting loneliness across the quarter. These results are both interesting and a limitation at the same time. It is very interesting to see that in fact temperament factors play a role in the development and change in loneliness. As far as we know, this is the first study to find that PA predicts change in loneliness controlling for baseline loneliness. It is certainly the first one to find that same result for EC. However, it is also a big limitation because we cannot make any conclusions based on these results because of the solely fact that they need replication in order to make any assumptions.

There are a number of other limitations in this study that should be considered. First, this study was conducted on a small sample of participants. None of the interactions were found, however the pattern of results indicate that with a bigger sample there would have been more power to achieve the interactions predicted. Because they are consistent vulnerabilities and the fact that can be interpreted in a way that make, there is no reason to discourage for further our research expecting significant results with a bigger sample that would allow for more statistical

power. Furthermore, having a bigger sample would also allow researchers to test the change in loneliness in a three-way interaction. Another limitation to consider when replicating the study is that this was an online format study. The fact that participants have complete control over when to complete questionnaires may have increased the possible error. Furthermore, our study relied only on self-reports questionnaires to assess temperament and loneliness. At last, our study was a longitudinal study that collected data on a period of eight weeks long. The fact that a person stayed lonely for the total eight weeks does not necessarily mean that the person is no longer experiencing acute loneliness but persistent loneliness instead. For loneliness to be considered persistent a longer longitudinal study may be necessary. A period of eight weeks could still be considered acute loneliness. Also, when doing a longitudinal study testing persistent loneliness, a longer longitudinal study would get more accurate results. A person who persists in loneliness for eight weeks could still be considered as someone who is suffering acute loneliness instead of persistent.

Future researchers should consider the current limitations in order to get more positive results and a better understanding on what are the risk factors and how they interact in predicting loneliness across time. If researchers could replicate the main effect results and further test the temperament model as interacting factors, we could get a better understanding of who is most vulnerable to persistent loneliness. By improving our understanding of who is at highest risk for persistent loneliness, it is hoped that we can create better ways of reducing such vulnerability. This understanding will permit better targeting and make better use of limited resources of prevention efforts.

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Footnotes

[1] Completers and dropouts were compared in all variables (NA, PA, EC, loneliness T1, and loneliness T2) and were not significantly different.